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(54) Abstract Title

Nested cylinders for locating downhole restrictions

(57) A downhole tool 11 for locating restrictions in boreholes comprises two or more bodies 24, 28, 44 located on an elongate support, such as a wireline 26, extending from the surface. Each body is of greater diameter than the one below and at least one is mounted movably with respect to the wireline so that on engaging with a restriction 18 in the borehole 22 it is supported and the weight on the wireline is reduced, indicating to the surface controller that a restriction has been located. The tool continues to run downhole and the narrower bodies progressively detect restrictions, such as scale, extending further into the bore. The locations of the restrictions are verified by detecting the increase in weight on the wireline as the tool is withdrawn. The bodies may incorporate channels 36, 46 to reduce drag and may be locked together by shear pins 66 which are broken by an impactor unit 62 once a restriction is encountered. The bodies may comprise a central shaft (A, figure 3) and a ring (B, figure 3) defining the diameter.

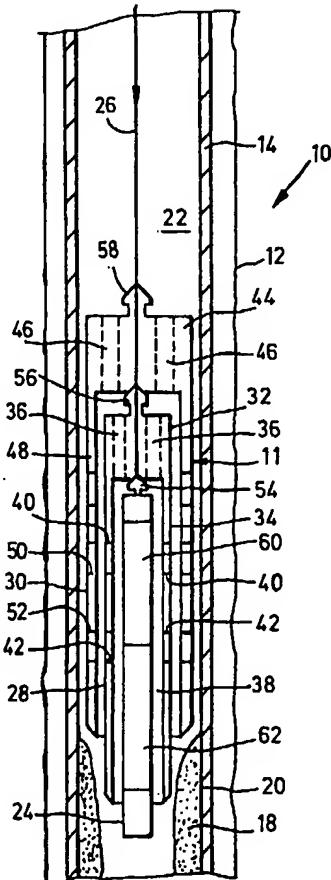


Fig.1

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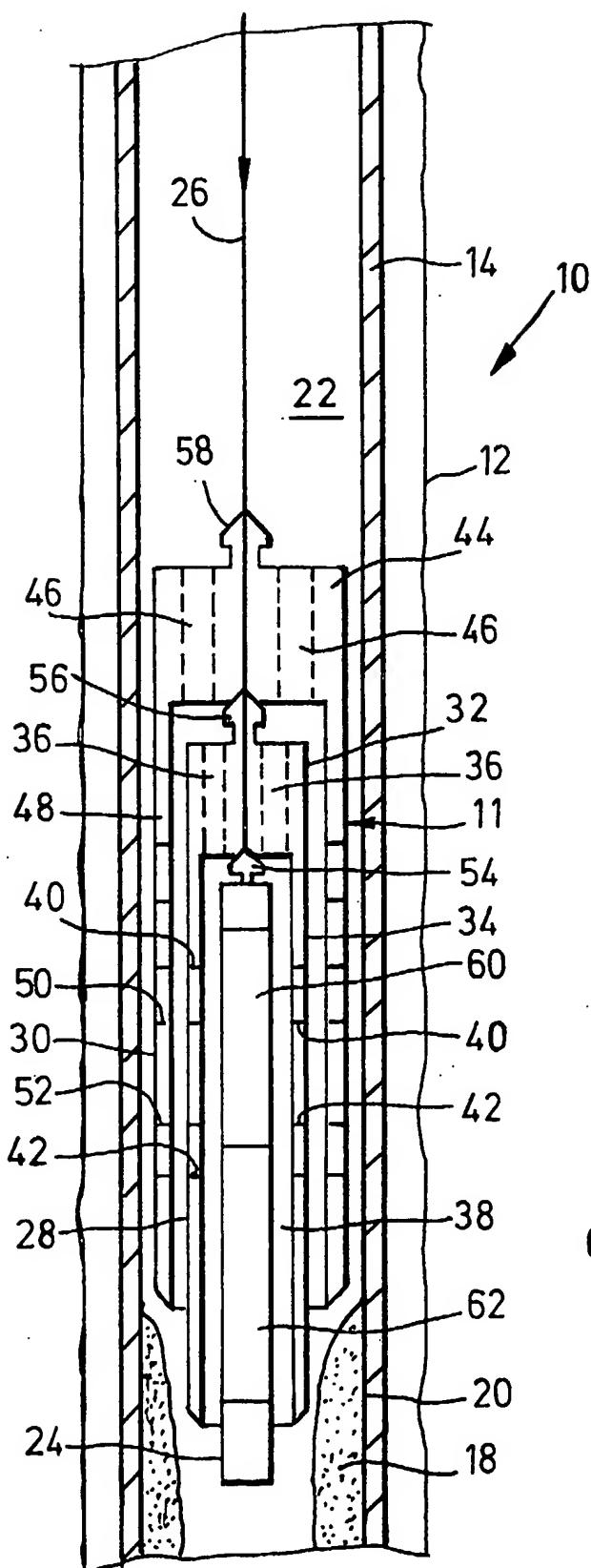


Fig.1

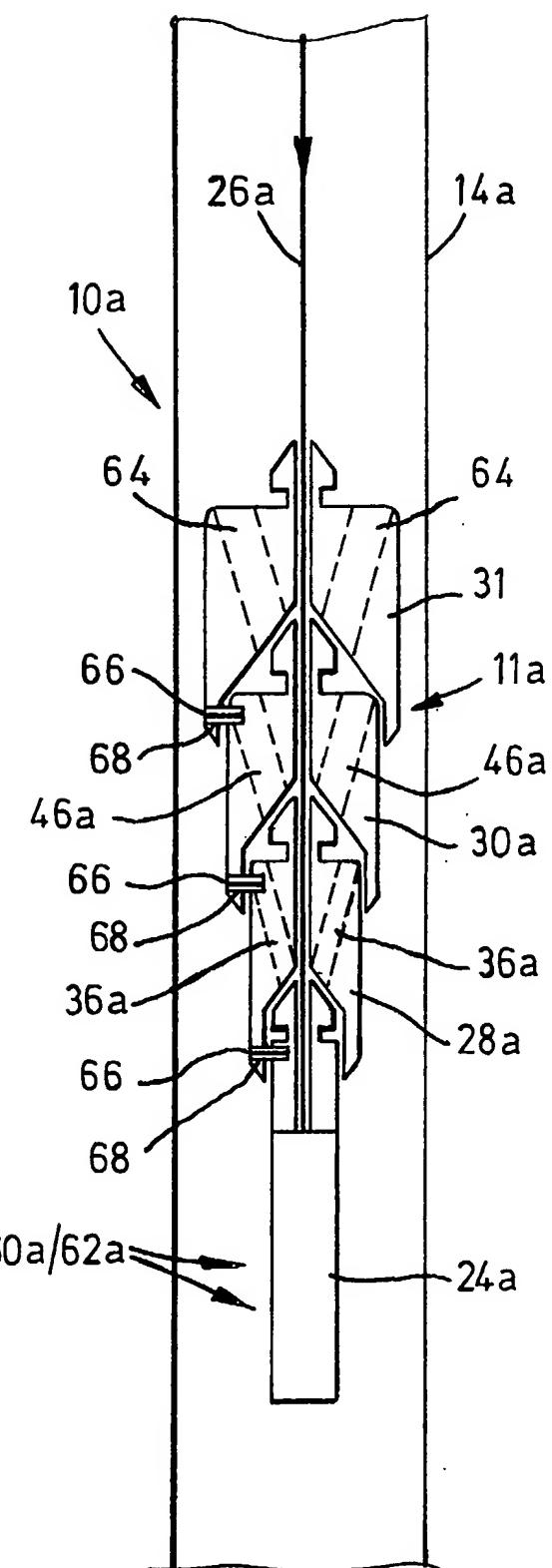


Fig.2

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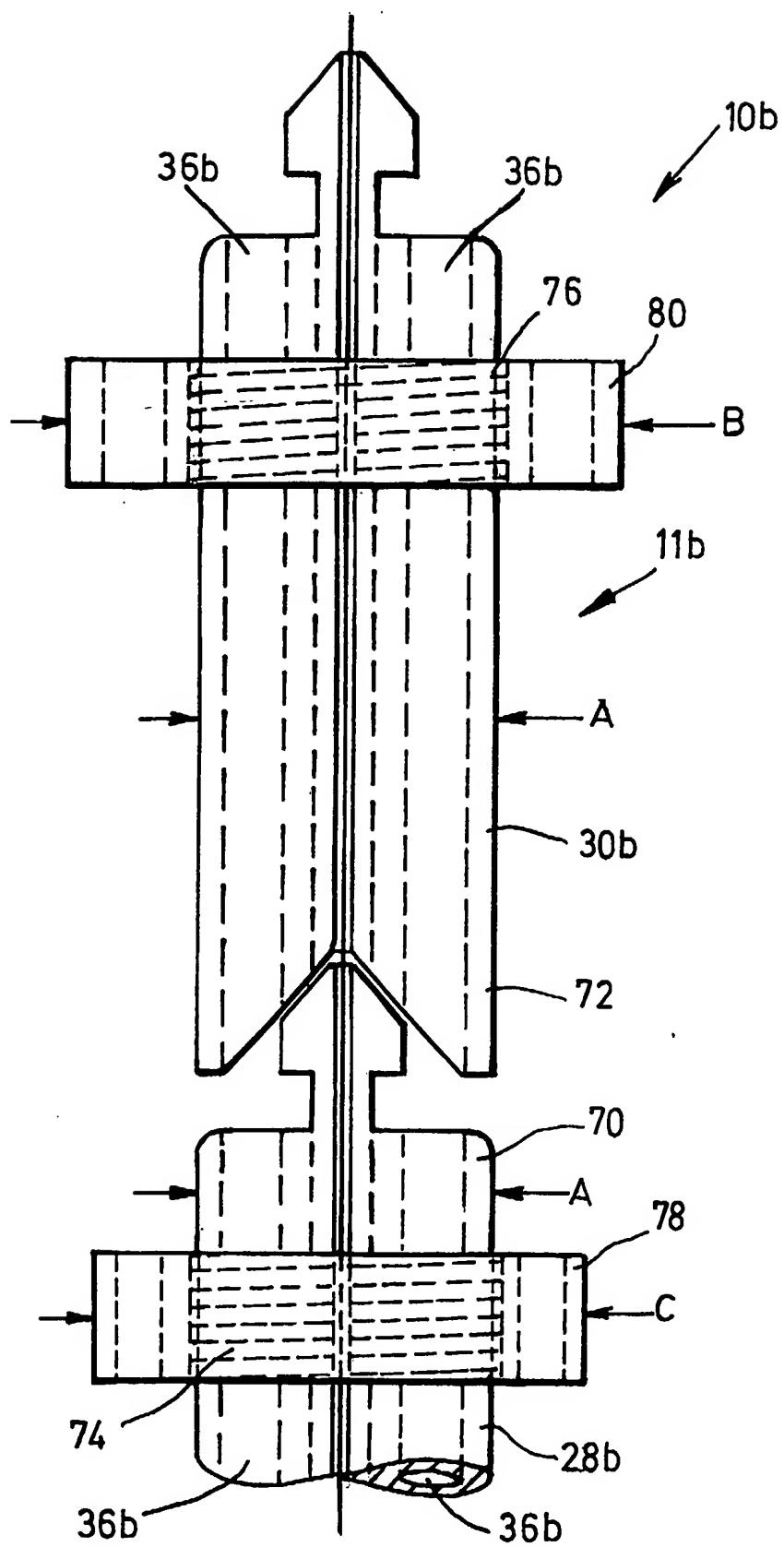


Fig.3

DOWNHOLE TOOL AND METHOD FOR LOCATING RESTRICTIONS

The present invention relates to a downhole tool for determining the location along a length of a borehole of a bore restriction, and to a corresponding method. In particular, but not exclusively, the present invention relates to a downhole tool and method for determining the location of a plurality of bore restrictions in a single tool run.

Scaling of oil and gas wells is a common problem in oil and gas exploration and production and occurs where produced water/emulsified oil and heavier fractions solidify and become adhered to the walls of a borehole, creating bore restrictions. This is a particular problem in borehole lining/tubing in completions where scaling reduces the available bore diameter, restricting the passage of well tools and production fluid flow.

To overcome this problem, it is necessary to run a milling tool downhole to remove the scale. However, this operation cannot be performed effectively and efficiently until the location of the restrictions, and the extent of the restrictions, has been determined. Accordingly, as a first step, it is necessary to carry out investigative operations to determine the location of the bore restrictions.

A simple method known in the industry is to carry out

multiple runs of a "drift" tool through the restricted bore on a slickline. The drift tool includes a tube or "drift" and when the tube encounters a bore restriction, it cannot pass any further downhole. The depth at which the tube
5 encounters the bore restriction is observed, and from this it can be determined that a restriction exists at that depth. Also, the radial extent of the restriction is known to be equivalent to the difference between the diameter of the unrestricted bore and the outer diameter of the tube.
10 The drift tool is then run-out and the tube is replaced with a second tube of a smaller outer diameter, which may pass further downhole for detecting more severe bore restrictions. The process is repeated using progressively smaller outer diameter tubes to obtain a map of the bore
15 restrictions along the length of the borehole. However, this process is time consuming, increasing rig time and expense.

A more complex method of determining the location of the bore restrictions involves running a memory or real-time caliper tool to develop a profile of the scale build-up along a length of tubing. This involves taking a series of measurements of the bore diameter with respect to borehole depth. However, this method has also been shown to be expensive in terms of rig time and, in addition, the
20 information obtained from the memory caliper is initially stored in an onboard memory. Accordingly, it is not known
25

that the required information has been correctly obtained until the tool memory is downloaded and analysed at the surface after the tool has been run-out. Also, both real-time and memory calipers include electronic/electrical components which may be sensitive to radiation, which is often encountered downhole and therefore may affect the reliability of data obtained using these tools. In addition, the calipers typically include four arms which are spaced at 90° around the tool, for detecting the bore restrictions. In practice, it has been found that such spaced arms have a tendency to fail to identify restrictions which cover only a small area of the tubing wall but which may extend relatively far into the bore.

Also, there is a need to verify the location of man-made restrictions set into a bore. Such restrictions may include nipples, packers, no-gos, liner tops or parts of valve assemblies.

It is amongst the objects of embodiments of the present invention to obviate or mitigate at least one of the disadvantages of existing drifts.

According to a first aspect of the present invention, there is provided a downhole tool for determining the location of a bore restriction, the tool comprising at least two bodies mountable on an elongate support extending from surface, the bodies defining respective outer diameters and each being configured to encounter a

respective bore restriction, at least one of the bodies being mountable on the elongate support for axial movement with respect to the support on said at least one of the bodies encountering a first bore restriction, to reduce the
5 weight of the tool depending from the support, and thus to allow the location of the first bore restriction to be determined.

Advantageously, the invention allows the location of two or more bore restrictions to be determined in a single
10 run and allows the location of the bore restrictions to be mapped, such that for example, an operation to remove the restrictions may be subsequently carried out efficiently, and targeted to the appropriate location.

Further advantageously, the present invention is not
15 affected by radiation experienced downhole due to, amongst other factors, the geological content of rock formations and deposition of Barium compounds found in some drilling fluids. This is in contrast to complex electronic tools such as real-time and memory calipers, whose reliability
20 cannot always be guaranteed in such circumstances.

The downhole tool may be for determining the location of a bore restriction along a length of tubing in a borehole, such as a borehole lining, well tubing, liner, casing or the like. The bore restriction may comprise
25 scale or other material adhered to a wall of the bore. However, the bore restriction may equally be a "man-made"

restriction such as a nipple, packer, no-go or part of a valve. The present invention may therefore advantageously be used to verify the location of the man-made restriction.

Preferably, the downhole tool comprises a plurality of bodies. The respective outer diameters of the bodies may progressively decrease such that a lowermost or innermost body defines the smallest outer diameter. Thus, advantageously, an uppermost body may define the largest outer diameter and is therefore configured to be impeded while being run into a bore by a relatively minor bore restriction. It will be understood that each body is configured to encounter a bore restriction which reduces the bore diameter to the outer diameter of the respective body. Thus the body outer diameters may be sized to be impeded by progressively larger bore restrictions. The axially moveable body may comprise a base member and a secondary member defining the respective outer diameter of the body. Accordingly, the outer diameter of the body, which is configured to encounter bore restrictions, may be defined by a secondary member which extends from a base member of the body. Only the axially moveable body may comprise such a base member and secondary member. Alternatively, every body of the tool may comprise a base member and a secondary member. The outer diameters of the respective secondary members may progressively decrease such that a lowermost or innermost body may include a

secondary member defining the smallest outer diameter. The secondary member is preferably adapted to be coupled to the base member, and may comprise a ring adapted to be coupled to the base member. The secondary member and the base member may include co-operating threads for coupling the secondary member to the base member. The at least two body base members or the base members of the axially moveable bodies may each be of the same outer diameter. Thus, the secondary members may be interchangeable, allowing a tool having any desired number of bodies and defining desired outer diameters to be provided. A lower edge, end or an outer surface of the at least one body may be adapted to engage a bore restriction, or the body base member may carry any suitable secondary member such as a sleeve, arms or other projections which are adapted to engage bore restrictions.

One body may be adapted to be fixed, and the at least one other body may be movably mountable with respect to the elongate support. Most conveniently, a lower body may be adapted to be fixed with respect to the elongate support and the at least one other body may be axially supported by the lower body. In some embodiments, the at least one other body may be adapted to initially be fixed with respect to the elongate support. The at least one other body may be initially fixable by a releasable restraint or coupling, such as a shear pin. Where more than one other body is

provided, each of the other bodies may be adapted to be coupled to an adjacent body by a releasable restraint, and one of the bodies may be adapted to be coupled to the lower, fixed body by a releasable restraint.

5 The bodies may define a cylindrical outer surface. Advantageously, this optimises the accuracy of the map of the bore restrictions which may be constructed through use of the tool. One of the bodies may be substantially cylindrical and the at least one other body may be tubular, 10 to permit the bodies to be nested. The cylindrical body may be a lower or inner body and may include impacting means for generating an impact or impulse load downhole, for assisting in dislodging any body of the tool which has become lodged in the bore. The impacting means may 15 comprise one or more hydraulic or spring loaded jars.

One or more of the bodies may define a fluid flow path therethrough. The fluid flow path may extend substantially axially through the at least one body. The inclusion of such flow paths may assist during running-in and pulling- 20 out of the tool from a liquid-filled borehole.

The inner diameter of the at least one body, disposed above an adjacent lower body, may be greater than the outer diameter of the lower body, to provide an annulus and allow fluid flow between an outer surface of the lower body and 25 an inner surface of the adjacent, upper body.

Each body may include a fishneck at an upper end

thereof to assist body retrieval.

The elongate support may comprise a wireline, in particular a slickline, and the downhole tool may be suspendable from an end of the wireline. Alternatively,
5 the elongate support may comprise another form of spoolable support such as coiled tubing.

According to a second aspect of the present invention, there is provided a downhole tool assembly for determining the location of a bore restriction, the tool assembly
10 including a downhole tool mounted on an elongate support extending from surface, the downhole tool comprising at least two bodies defining respective outer diameters and each being configured to encounter a respective bore restriction, at least one of the bodies being mounted on
15 the elongate support for axial movement with respect to the support on said at least one of the bodies encountering a first bore restriction, to reduce the weight of the tool assembly depending from the support and allow the location of the first bore restriction to be determined.

20 An inner or lower body may be fixed to the elongate support and the at least one other body may be movably mounted on the elongate support and axially supported by the lower body, or by a stop provided on the elongate member. The at least one movably mounted body may be
25 slidable on the elongate support. The elongate support may comprise a slickline and the downhole tool may be suspended

from the end of the slickline. The at least one other body may be initially fixed relative to the support by a releasable restraint, such as a shear pin. Where more than one other body is provided, each of the other bodies may be
5 coupled together by a releasable restraint, and one of the bodies may be to be coupled to a lower, fixed body by a releasable restraint.

The downhole tool assembly may further comprise depth determining means associated with the elongate support, for
10 measuring the depth of the downhole tool in the borehole to determine the location of the bore restriction. The depth determining means may comprise a measuring device located at surface which is adapted to measure the length of elongate member, typically slickline, which has been run
15 into the bore.

Further features of the downhole tool are defined with respect to the first aspect of the invention.

According to a third aspect of the present invention, there is provided a method of determining the location of
20 a bore restriction, the method comprising the steps of:

mounting at least two bodies on an elongate support to form a tool assembly, the bodies defining respective outer diameters, and at least one of the bodies being axially movably mounted with respect to the elongate support;

25 running the tool assembly down into a bore until a movably mounted first body encounters a first restriction

and is supported in the bore by said first restriction;

observing the drop in weight suspended from the support corresponding to the weight of the first body due to the first body becoming so restrained;

5 observing the depth at which the weight drop occurred, to determine the depth of the first restriction in the bore; and

continuing to run the remaining tool assembly through the bore to determine the location of a further
10 restriction.

The method may further comprise determining the location of three or more bore restrictions in a single run. This is particularly advantageous in that rig time is reduced when compared to methods of locating restrictions
15 using a conventional drift. Also, observing the weight drop and depth at which the weight drop occurs provides an instant indication of the presence of a bore restriction, without requiring the provision of additional sophisticated apparatus and without the need to pull the tool assembly to
20 surface to obtain results, thus providing an accurate, real-time map of the bore restrictions.

Preferably, the step of mounting at least two bodies further comprises mounting more than two bodies, in particular a plurality of bodies, on the elongate support,
25 each body for encountering a bore restriction of respective predetermined extent. The bodies may be mounted on an

elongate support comprising a wireline, such as a slickline, and a lower body may be fixed to the elongate support such that the at least one other body is axially supported by and movable with respect to the lower body.

5 The at least one other body may be initially fixed with respect to the elongate support by a releasable restraint such as a shear pin. This may advantageously prevent inadvertent release of the moveable body, for example, during running-in to a deviated bore.

10 The method may further comprise the step of confirming the location of the bore restrictions by observing an increase in the weight of the tool assembly suspended by the support during running out, the weight increase occurring when a body is picked up by the tool assembly, 15 and observing the depth at which the weight increase occurs.

The method may also further comprise the step of exerting an impact or impulse downhole on a body, to dislodge a body from the bore in the event of the body becoming stuck during running-out of the tool assembly. 20 The step of exerting an impact may comprise activating an impacting means associated with one of the bodies, preferably a lower body, to generate an impact load, and transmitting the impact load to a lodged body. The impact load may be hydraulically or mechanically generated by a 25 hydraulic or spring loaded jar.

There follows a description of embodiments of the present invention, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a schematic, longitudinal sectional view 5 of a downhole tool assembly incorporating a downhole tool, in accordance with an embodiment of the present invention, shown during run-in to a borehole;

Figure 2 is a schematic, longitudinal sectional view 10 of a downhole tool assembly incorporating a downhole tool, in accordance with an alternative embodiment of the present invention, shown during run-in to a borehole; and

Figure 3 is a schematic, longitudinal sectional view 15 of part of a downhole tool assembly incorporating a downhole tool, in accordance with a further alternative embodiment of the present invention.

Referring firstly to Figure 1, there is shown a downhole tool assembly in accordance with an embodiment of the present invention, the tool assembly indicated generally by reference numeral 10, and which includes a 20 downhole tool 11. The tool assembly is shown while being run into a borehole 12 which has been lined with a liner 14 that extends downwardly from an upper, cemented casing (not shown) in a fashion known in the art. Scale in the form of produced water/emulsified oil and heavier fractions of the 25 produced fluid is illustrated schematically at 18, the scale forming over time on an inner surface 20 of the liner

14. The scale 18 causes a restriction to the passage of tools and fluid through the liner bore 22, and requires to be removed in a milling or drilling operation, to regain full bore communication.

5 As will be described, the tool assembly 10 is run into the liner 14 to determine the location and extent of the scale 18 along the length of the liner 14, such that the appropriate milling operation can then be performed in the area of the scale 18.

10 The downhole tool 11 comprises a lower cylindrical body 24 which is suspended from the end of a slickline 26, and upper bodies in the form of tubes or shells 28 and 30. The bodies 24, 28 and 30 vary in outer diameter from 1" to 4.5" in steps of 1.5". Also, the bodies are of the same material and volume and thus of equal weight, in this case around 40lbs. It will be understood that, for ease of illustration, the tool assembly 10 is shown including only three bodies 24, 28 and 30, but that any desired number of bodies may be provided.

15

20 Each of the two upper bodies 28 and 30 is movably mounted on the slickline 26 and is supported, ultimately, by the fixed lower body 24. An upper end of the intermediate body 28 forms a collar 32 for mounting the body 28 on the slickline 26 and for supporting the body 28
25 on the lower body 24. A tubular skirt 34 extends downwardly from the collar 32 and partially surrounds the

lower body 24. A number of bores 36 extend through the collar 32 to define flow paths for fluid to pass through the collar. This allows fluid to flow upwardly through an annulus 38 formed between an inner surface of the skirt 34 and an outer surface of the lower body 24, during run-in and run-out from the borehole 12. This also allows fluid flow through the collar 32 after the body 28 has encountered a scale restriction in the liner 14, as will be described below. Also, a number of apertures 40 and 42 are provided spaced around a circumference of the tubular skirt 34 to allow fluid flow therethrough.

The outermost, upper body 30 is similar in structure to the intermediate body 28, except that the body 30 is of a larger diameter. A collar 44 of the body 30 includes bores 46 and a tubular skirt 48 of the body 30 includes apertures 50 and 52, to allow fluid flow as described above.

It will be noted that the outer diameter of the bodies progressively increases from the lower body 24. Also, each of the bodies 24, 28 and 30 include respective fishneck profiles 54, 56 and 58 which can be engaged by a retrieval tool (not shown), to facilitate retrieval of any one of the bodies in the event of, for example, the slickline 26 parting.

The lower body 24 carries jars 60 and 62, typically hydraulic or spring-loaded jars, which can be used to

generate an upwardly-directed impact force on the bodies 24, 28, 30 should they become lodged in the bore.

In use, the tool assembly 10 is coupled to the slickline 26 and run-into the liner 14. As the tool 5 assembly 10 is lowered, the body 30 of the largest outer diameter first encounters the bore restriction created by the scale 18 and is restrained from further axial downward movement when the extent of scale is such that the minimum diameter of the restricted bore is the same as or smaller 10 than the diameter of the body 30. When the body 30 encounters and is then supported by the scale 18, the weight of the remaining tool assembly suspended from the slickline 26 drops by 40 lbs as the assembly is lowered beyond the restriction. This change in weight is 15 detectable at surface by a sensor in the form of a depth\tension device conventionally associated with a wireline spooling apparatus (not shown), such as a weight indicator. This indicates to the slickline operator the depth at which this weight loss occurs. Accordingly, this provides an indication of the location along the length of 20 the liner 14 at which the casing bore 22 has been reduced in diameter by the scale 18 to be equivalent to the outer diameter of the body 30.

The remainder of the tool assembly 10 is then lowered 25 further through the liner 14 until the body 28 (of the next largest outer diameter) encounters a more severe

restriction caused by the scale 18, and the weight of the tool assembly 10 suspended from the slickline 26 drops by a further 40 lbs. Once more, the operator can determine the location along the liner 14 where the scale 18 has 5 reduced the bore diameter, in this case, to the outer diameter of the body 28.

The lower body 24 is then again lowered through the liner 14 and, on encountering scale 18 causing a still more severe restriction, the slickline 26 becomes slack, and the 10 location of the restriction is determined by the point at which the slickline 26 becomes slack. Thus the location at which the bore 22 is reduced to the diameter of the lower body 24 outer diameter can be determined.

The tool assembly 10 is then run out of the hole by 15 pulling the lower body 24 upwardly through the liner 14 on the slickline 26, collecting the bodies 28 and 30 on its way up. The weight of the tool assembly thus increases by 40 lbs as each body 28 and 30 is picked up, and the location of the scale restrictions can thus be checked by 20 observing the location along the liner 14 at which the weight increases.

Turning now to Figure 2, there is shown a downhole tool assembly in accordance with an alternative embodiment of the present invention, and indicated generally by 25 reference numeral 10a. Like components of the tool assembly 10a with the tool assembly 10 of Figure 1 are

indicated by the same reference numerals, with the addition of the suffix letter "a".

The tool assembly 10a is similar to the assembly 10, except that the downhole tool 11a includes four bodies in the form of a lower body 24a, intermediate tubular bodies 28a, 30a and a further body 31, each body of progressively increasing outer diameter. Each of the bodies 28a, 30a and 31 are shorter in length than the corresponding bodies of the tool assembly 10, to reduce the overall length of the tool assembly 10a. Each of the bodies 28a, 30a, 31 also includes a number of angled bores 36a, 46a and 64 respectively, to allow fluid flow therethrough. Jars 60a, 62a are provided in the body 24a.

The bodies 24a, 28a, 30a and 31 are each initially coupled together, and thus restrained from independent movement, by shear pins 66. The shear pins 66 are located in aligned apertures 68 extending through adjacent pairs of the bodies. Thus, the upper body 31 is initially coupled to the intermediate body 30a, which is in turn coupled to the intermediate body 28a. Similarly, the intermediate body 28a is coupled to the lower body 24a.

This arrangement ensures that the moveably mounted bodies 28a, 30a and 31 do not inadvertently separate from the tool assembly 11a, providing a false indication of the presence of a bore restriction. Such may occur in particular in deviated wells, where frictional forces are

experienced by the outermost body through contact with the liner 14a wall during running-in.

The shear-pins 66 are rated to shear at a force greater than any such anticipated frictional force likely 5 to be experienced by the bodies. Thus, when a true bore restriction is encountered by the upper body 31, the entire tool 11a will be restrained and the slickline 26a will become slack. The tool operator then exerts a jarring force on the body 31, through the jars 60a, 62 to shear the 10 pin 66 coupling the bodies 31 and 30a together, or by picking up and dropping the tool 11a at a velocity sufficient to shear the pin 66 on the body 31 encountering the restriction. The body 31 is then separated and the weight drop observed as before. The process is repeated 15 for each of the other pinned bodies 30a and 28a.

Referring now to Figure 3, there is shown a schematic, longitudinal sectional view of part of a downhole tool assembly in accordance with a further alternative embodiment of the present invention, the tool assembly 20 indicated generally by reference numeral 10b, and which includes a downhole tool 11b. Like components of the assembly 10b with the assembly 10 of Figure 1 share the same reference numerals with the addition of the suffix letter "b".

25 In Figure 3, only two bodies 28b and 30b are shown, however, these bodies are mounted on a lower cylindrical

body such as the body 24 of Figure 1. The bodies 28b and 30b each comprise a base member in the form of tubes 70, 72 of the same outer diameter, as indicated at A in Figure 3. The tubes 70 and 72 are threaded at 74, 76 respectively and 5 secondary members in the form of threaded rings 78, 80 are coupled to the tubes 70, 72, respectively. The threaded ring 80 on the upper tube 72 is of a greater outer diameter B than the threaded ring 78 on the lower tube 70, which is of an outer diameter C, as shown in the Figure. The rings 10 78, 80 thus define the outer diameters of the bodies 28b, 30b respectively.

Each of the tubes 70, 72 include bores 36b for fluid flow through the respective tube and the bodies 28b, 30b are initially restrained from independent movement by shear pins (not shown), such as the shear pins 66 which couple the bodies 24a, 28a, 30a and 31 of the tool 11a shown in 15 Fig. 2.

When the tool assembly 10b is lowered through the borehole the uppermost ring 80 first encounters scale and 20 when the pin connecting the body 30b to the body 28b is sheared, the body 30b lifts off the body 28b and provides an indication of the location of the scale. The assembly 10b is lowered again until the ring 78 encounters scale further down the borehole, as described in relation to the 25 assemblies 10, 10a of Figures 1 and 2.

Provision of a structure including a number of bodies

with base tubes of the same outer diameter (A) allows a ring of any desired diameter to be coupled to the base tubes. Thus, the bodies 28b, 30b may be adjusted to define any desired outer diameter simply by coupling a threaded 5 ring of the desired outer diameter to the base tube 70, 72 respectively. This provides versatility in the operation of the assembly 10b.

Various modifications may be made to the foregoing 10 embodiments within the scope of the present invention. For example, the bodies may be of any desired outer or inner 15 diameter, and any desired shape or weight. Each body may carry a secondary member such as a ring, sleeve, arms or other projections which are adapted to define the effective diameter of the body and intended to engage bore restrictions of corresponding extent.

The tools may be utilised for detecting restrictions 20 of any form in any downhole liner casing, tubing or the like. The tool assembly of Figure 1 may include shear pins, in a similar fashion to the assembly of Figure 2, or the Figure 2 assembly may be provided without shear pins.

The body ring may be coupled to the base tube in any suitable fashion, for example, by shear pins, locking dogs, a latch or lock such as a lock ring or the like. Each of 25 the tool assemblies described above may each include only bodies which are axially moveably mounted on the wireline.

CLAIMS

1. A downhole tool for determining the location of a bore restriction, the tool comprising at least two bodies mountable on an elongate support extending from surface, the bodies defining respective outer diameters and each being configured to encounter a respective bore restriction, at least one of the bodies being mountable on the elongate support for axial movement with respect to the support on said at least one of the bodies encountering a first bore restriction, to reduce the weight of the tool depending from the support, and thus to allow the location of the first bore restriction to be determined.
- 15 2. A downhole tool as claimed in claim 1, further comprising a plurality of bodies mountable on the elongate support for axial movement with respect to the support.
- 20 3. A downhole tool as claimed in either of claims 1 or 2, wherein the respective outer diameters of the bodies progressively decreases such that a lowermost body defines the smallest outer diameter.
- 25 4. A downhole tool as claimed in any preceding claim wherein the at least one axially moveable body comprises a base member and a secondary member defining the respective

outer diameter of the body.

5. A downhole tool as claimed in any one of claims 1 to
4, wherein the bodies each comprise a base member and a
5 secondary member, the secondary member defining the
respective outer diameter of the body.

6. A downhole tool as claimed in either of claims 4 or 5,
wherein the secondary member is adapted to be coupled to
10 the base member.

7. A downhole tool as claimed in claim 6, wherein the
secondary member comprises a ring.

15 8. A downhole tool as claimed in either of claims 6 or 7,
wherein the secondary member and the base member include
co-operating threads for coupling the secondary member to
the base member.

20 9. A downhole tool as claimed in any one of claims 4 to
8, wherein the base members of each body are of the same
outer diameter.

25 10. A downhole tool as claimed in any preceding claim,
wherein a lower body is adapted to be fixed against axial
movement with respect to the elongate support and the at

least one other body is axially supported by the lower body.

11. A downhole tool as claimed in any preceding claim,
5 wherein the at least one other body is adapted to initially
be fixed with respect to the elongate support.

12. A downhole tool as claimed in claim 11, wherein the
tool includes a plurality of bodies mountable on the
10 elongate support for axial movement with respect to the
support, each of said bodies being adapted to be coupled to
an adjacent body by a releasable restraint, and one of the
bodies is adapted to be coupled to a lower, fixed body by
a releasable restraint.

15

13. A downhole tool as claimed in any preceding claim,
wherein the bodies define a cylindrical outer surface.

14. A downhole tool as claimed in any preceding claim,
20 wherein one of the bodies is substantially cylindrical and
the at least one other body is tubular.

15. A downhole tool as claimed in claim 14, wherein the at
least one body includes impacting means for generating an
25 impact load downhole.

16. A downhole tool as claimed in any preceding claim, wherein at least one of the bodies defines a fluid flow path therethrough.

5 17. A downhole tool as claimed in any preceding claim, wherein each body includes a fishneck at an upper end thereof.

10 18. A downhole tool assembly for determining the location of a bore restriction, the tool assembly including a downhole tool mounted on an elongate support extending from surface, the downhole tool comprising at least two bodies defining respective outer diameters and each being configured to encounter a respective bore restriction, at 15 least one of the bodies being mounted on the elongate support for axial movement with respect to the support on said at least one of the bodies encountering a first bore restriction, to reduce the weight of the tool assembly depending from the support and allow the location of the 20 first bore restriction to be determined.

19. A downhole tool assembly as claimed in claim 18, wherein a lower body is fixed to the elongate support and the at least one other body is movably mounted on the 25 elongate support and axially supported by the lower body.

20. A downhole tool assembly as claimed in either of claims 18 or 19, wherein the at least one movably mounted body is slidable on the elongate support.

5 21. A downhole tool assembly as claimed in any one of claims 18 to 20, wherein the at least one other body is initially fixed relative to the support by a releasable restraint.

10 22. A downhole tool assembly as claimed in any one of claims 18 to 21, wherein the elongate support comprises a slickline and the downhole tool is suspended from the end of the slickline.

15 23. A downhole tool assembly as claimed in any one of claims 18 to 22, wherein the downhole tool includes a plurality of bodies mounted on the elongate support for axial movement with respect to the support, each of said bodies coupled to an adjacent body by a releasable restraint, and wherein one of said bodies is coupled to a lower, fixed body by a releasable restraint.

20 24. A downhole tool assembly as claimed in any one of claims 18 to 23, further comprising depth determining means associated with the elongate support, for measuring the depth of the downhole tool in the borehole to determine the

location of the first bore restriction.

25. A downhole tool assembly as claimed in claim 24,
wherein the depth determining means comprises a measuring
5 device located at surface which is adapted to measure the
length of elongate member which has been run into the bore.

26. A method of determining the location of a bore
restriction, the method comprising the steps of:

10 mounting at least two bodies on an elongate support to
form a tool assembly, the bodies defining respective outer
diameters, and at least one of the bodies being axially
movably mounted with respect to the elongate support;

15 running the tool assembly down into a bore until a
movably mounted first body encounters a first restriction
and is supported in the bore by said first restriction;

observing the drop in weight suspended from the
support corresponding to the weight of the first body due
to the first body becoming so restrained;

20 observing the depth at which the weight drop occurred,
to determine the depth of the first restriction in the
bore; and

25 continuing to run the remaining tool assembly through
the bore to determine the location of a further
restriction.

27. A method as claimed in claim 26, further comprising determining the location of at least three bore restrictions in a single run.

5 28. A method as claimed in either of claims 26 or 27, further comprising mounting the bodies on a wireline with a lower body fixed to the wireline such that the at least one other body is axially supported by and movable with respect to the lower body.

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29. A method as claimed in claim 28, further comprising initially fixing the at least one other body with respect to the elongate support by a releasable restraint.

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30. A method as claimed in any one of claims 26 to 29, further comprising the step of confirming the location of the bore restrictions by observing an increase in the weight of the tool assembly suspended by the support during running out, and observing the depth at which the weight increase occurs.

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31. A method as claimed in any one of claims 26 to 30, further comprising the step of exerting an impact or impulse downhole on a body, to dislodge a body from the bore in the event of the body becoming stuck during running-out of the tool assembly.

32. A downhole tool substantially as described herein with reference to and as shown in Figure 1.

5 33. A downhole tool substantially as described herein with reference to and as shown in Figure 2.

34. A downhole tool substantially as described herein with reference to and as shown in Figure 3.



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Claims searched: 1-34

29

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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

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Other: Online: EPODOC, WPI & JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A, P	EP 1201875 A2 (QUARTECH ENGINEERING LTD.)	

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|---|--|
| X Document indicating lack of novelty or inventive step | A Document indicating technological background and/or state of the art. |
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